

6. ENGINEERING SYSTEMS REQUIREMENTS

G40 SITE ELECTRICAL UTILITIES

SYSTEM DESCRIPTION

The site electrical utility system consists of all power and telecommunications and fiber optic cabling from the existing distribution system point of connection including all connections, accessories and devices as necessary and required for a complete and usable system. This section covers installations up to within 5 feet (1.5 meters) of new (or existing) building location.

Site Electrical and Utilities shall comply with all requirements in UFC 3-501-01 *Electrical Engineering*, UFC 3-550-01 *Exterior Electrical Power Distribution with Change 1*, UFC 3-575-01 *Lightning and Static Electricity Protection Systems*, UFC 3-560-01 *Electrical Safety, O&M, with Change 5*, IEEE C2 *National Electrical Safety Code*, and NFPA 70 *National Electrical Code*.

During the installation process, the power/electrical downtime for any downstream loads shall be limited to 8hr timeframes. The request shall be made to the Contracting Officer. The Contracting Officer shall notify the Contractor of approval. All interruptions of power shall be scheduled with the government at least three weeks in advance

GENERAL SYSTEM REQUIREMENTS

Provide an Electrical System complete in place, tested and approved, as specified throughout this RFP, as needed for a complete, usable and proper installation. All equipment shall be installed per the criteria of PTS Section G40 and the manufacturer's recommendations. Where the word "should" is used in the manufacturer's recommendations, substitute the word "shall".

Provide a 10 MVA ONAN / 12.5MVA ONAF medium voltage substation, 34.5kV class primary, 15kV class secondary. The Substation shall be named "*WTBn Switchyard*". Substation shall be radially fed from the 34.5kV pole adjacent to the existing NOC substation on Hot Patch Road; provide a new fused cutout on the existing 34.5kV source pole. Provide 4-way, 5-inch, underground concrete encased ductbank from the 34.5kV DVP source to the new 10/12.5MVA substation site (see Part 6 drawings). Provide primary and secondary switches with motor operators as indicated and SCADA control capability for integration in a future microgrid. Provide primary and secondary metering on each switch, compatible with the base existing AMI system. For information on the existing AMI metering system, please contact the Quantico PWD Electrical Engineer as follows:

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Secondary 15kV underground ductbank from the WTBn Switchyard shall reconnect to the existing overhead distribution north of MCB-4.

Substation shall be surrounded by a 10-foot high fence topped with 3-strand barbed wire at 45 degrees outward, and with a screen that will block direct view of the equipment through the fence.

All equipment shall be mounted on a common pad surrounded by 56-stone and gravel fill to the fence line and for the driveway from the gate to the road. Provide space for maintenance clearance as required by NEC, NESC, and UFC 3-550-01 *Exterior Electrical Power Distribution with Change 1*; in addition provide space for a GFGI storage shed within the fence while maintaining all clearance requirements. Provide gate and gravel drive to the substation of sufficient size for a truck carrying the largest component to pass through the gate and perform the replacement. Provide grounding as required by NEC, NESC, and UFC 3-550-01 *Exterior Electrical Power Distribution with Change 1*.

All switches, transformers, and equipment shall be UL Listed.

Provide site electrical utilities systems and components that support project sustainability goals as indicated in Part 2.0 Project Objectives, paragraph 2.3.

13.2kV service shall be extended to the project site buildings underground in ductbank to a Pad Mounted Transformer at each building.

A complete electrical system demand, load flow study, and selective coordination study shall be performed for the Quantico 15kV and 35kV electrical distribution system from the upstream protective devices, through the WTBn Switchyard protective devices, the building transformers, and into the buildings. Obtain the following from the Utility:

- Maximum available fault current available at the utility connection point
- Existing settings of Dominion Power's 34.5kV protective device(s)

Coordination Study shall selectively coordinate utility devices with downstream devices. Refer to ESR D50, UFC 3-501-01 *Electrical Engineering*, UFC 3-550-01 *Exterior Electrical Power Distribution*, and FC 1-300-09N *Navy and Marine Corps Design Procedures*, for additional calculation, load flow, coordination study, short circuit, and arc flash analysis requirements.

G409007 PHOTOVOLTAIC ENERGY SYSTEM

Not Used

G4010 ELECTRICAL DISTRIBUTION

Connect to the existing 34.5kV, 3-phase, 3-wire, 60-Hertz electrical power system. The connection point shall be underground to the 35kV pole adjacent to the existing NOC Substation on Hot Patch Road. Extend 35kV class EPR to the project site underground in concrete encased ductbank to a pad mounted primary switch, 34.5kV - 13.2Y/7.62kV transformer, and secondary 6-way distribution switchgear. All materials shall be copper. All conductors shall be copper. All termination devices shall be copper. Minimum conduit size for 15kV and 35kV class ducts shall be 6". Provide Nexus 1272 meter and connect to the base existing AML system.

Primary Switch: 38kV class, 4-way, SF₆ type switch. Provide motor operators as indicated and remote supervisory and metering capability for connection to a future microgrid SCADA system.

Distribution Switch: 6-way SF₆ type pad mounted switchgear, 95kV BIL, 600A SF₆. Two source, primary selective interlocked in a utility source transfer configuration to a common bus – Input 1 shall be 1 from the new transformer, Input 2 shall originate from the existing overhead distribution on the north side of Rt. MCB-4. Interrupt overhead distribution north of MCB-4 and reroute underground to the new substation. Provide four distribution switch-ways. Provide motor operators. Provide remote supervisory capability for connection to a future microgrid SCADA system.

Substation shall include:

- Incoming 4-way, 6-inch concrete encased ductbank
 - Primary Conductor: Provide 250kcmil copper, 35kV, 133%, EPR phase conductors in accordance with UFC 3-550-01 Exterior Power Distribution.
- 35kV Class, 4-way Primary Switch
 - Pad Mounted NEMA3R non-walk-in enclosure
 - 600A, to allow future extension or increased load on the 34.5kV
 - Control Power Transformer
 - 150kV BIL minimum
 - Load break switches with interrupting rating of 12,500 amps, symmetrical
 - Interlocked Ground switch on all switch-ways
 - Visual switch position indicators
 - Phase and Ground Fault interruption by programmable overcurrent controls with curve selection and time dial settings via local and via remote computer interface
 - All ways shall include surge arrestors
- 34.5kV to 13.2Y/7.62kV 10MVA ONAN / 12.5 MVA ONAF substation transformer
 - Coordinate exact values for required primary and secondary voltages and delta/wye configuration with the government.
 - Pad mounted
 - Copper windings
 - Grain oriented laser scribed steel core
 - Less-flammable bio-degradable liquid insulated FR3 type
 - Average winding temperature rise above ambient temperature, when tested at the transformer rating shall not exceed 55° C, when tested at 112% of the base rating shall not exceed 65° C, and when tested at 122% of the base rating shall not exceed 75° C.
 - 150kV BIL minimum
 - 7.5% impedance
 - Three surge arresters
 - Weatherproof, NEMA 4 terminal box which shall accommodate control wiring from the transformer to the RTU inside the switch
 - Two – 2 ½% taps above and below rated voltage
 - Pressure-relief valve
 - Sudden Pressure relief relay activation indicator with remote monitoring capable/digital output
 - Top oil temperature indicator with remote monitoring capable/digital output
 - Winding temperature indicator with remote monitoring capable/digital output
 - Low Liquid level indicator with remote monitoring capable/digital output
 - Dead-Front Design with ANSI specific front plate spacing
 - High voltage bushings - 600A dead-break primary bushing, externally removable

Substation transformer shall be provided with SCADA compatible meter and communication compatible with the Quantico base SCADA standards and connect to the existing SCADA network.

- SCADA shall provide metering and monitoring for the following measurements:

- AC current (amperes) in A, B and C phase, 3-phase average, Neutral (N) and Ground (G). A total of five (5) current inputs shall be provided. Accuracy of all current inputs shall be 0.05% reading, +/- 0.01% of full scale.
- AC voltage (volts) for A-B, B-C and C-A, phase average, A-N, B-N and C-N, average phase to N, and N to G. Accuracy of all voltage inputs shall be +/- 0.1% reading, +/- 0.05% maximum of full scale
- Auxiliary AC voltage (volts) for A2-B2, B2-C2, and C2-A2, phase average. Accuracy of all voltage inputs shall be +/- 0.1% reading, +/-0.05% maximum of full scale. Capable of metering up to 600 volt without external Potential Transformers (PTs) and up to 500 kV with appropriate PTs.
- Real Power (Watts), Reactive Power (vars), Apparent Power (VA), for each phase and system. Accuracy +/- 0.10% reading and +/- 0.0025% full scale. Forward/Reverse indication shall be provided.
- Frequency (Hz) Accuracy +/- 0.01 hertz.
- Demand values including present, running average, last complete interval and peak for System Current (Amperes). Demand values including present, running average, last complete interval, peak and coincident with peak kVA and kW demand for System Real Power (Watts), System Reactive Power (vars), and System Apparent Power (VA).
- Power Factor for both Displacement only 60-cycle fundamental Watts to VA and Apparent total Watts to total vars including harmonics for A, B and C phase and 3 phase average. Accuracy +/- 0.10% at unity PF and +/-0.30% at 0.5 PF.
- 600A, 13.2kV, SF₆ Secondary Switches
 - Pad Mounted NEMA3R non-walk-in enclosure
 - 2 SF₆ switch-ways configured as Primary selective motor-operated
 - Source transfer control automation of two (2) primary sources; programmable source transfer control settings via local interface and via remote SCADA computer interface – connected and disabled; for future SCADA microgrid.
 - All ways shall include surge arrestors
 - Load interrupting rating of 12,500 amps, symmetrical minimum
 - 4 SF₆ switch-ways SF₆ distribution switches
 - Provide motor actuator arms for future capacitor charged motor operator
 - Provide SCADA and metering cabinet in separate enclosure at the end of each switch line-up.
 - SCADA communication via FO OSP
 - Metering with communication compatible with Quantico AMI
 - Control Power Transformer
- Outgoing 12-way 6-inch ductbank
 - Secondary cable shall be 500kcmil, copper, 15kV, 133%, EPR in accordance with UFC 3-550-01 Exterior Power Distribution (500A @ 13.2kV in duct).
- Qty 2 – 120v secondary, pad mounted station transformers
 - 2N station power - Size each transformer to provide power for communications, metering, station lighting, convenience receptacles, and all ancillary equipment, plus 25% spare capacity.
 - Provide primary surge arrestors
 - Provide primary switch
- Provide 120v, NEMA3R primary selective panelboard for local station loads, +25% spare capacity

- 2-way 4-inch ductbank to the nearest telecommunication manhole, for communications and metering.
- Provide a system of 2-way, 4-inch ductbank, fabric mesh innerduct, and handholes buried adjacent to the medium voltage 34kV ductbank from WTBn Switchyard to the NOC substation for SCADA communications.
 - Provide 12-strand, single mode fiber optic cable IAW G4030 from Switchyard WTBn for SCADA controls and meter communication to the existing NOC Substation and connect to existing SCADA controller in the NOC substation as directed by the government.
 - Provide 12-strand, single mode fiber optic cable IAW G4030 from Switchyard WTBn to the NMCI telecommunications room in the BEQ building and connect to fiber optic patch panel as directed by the government.
- Contiguous equipment pad surrounded by stone and gravel yard
- Lightning protection and grounding in accordance with UFC 3-550-01.
- Space for a future GFGI 8'x10' storage shed with double doors, for storing parts and tools
- 10' chain link fence with 3-strand barbed wire top at a 45deg outward angle
- A gravel driveway for access
- Pole mounted LED lighting
- Convenience receptacles – Provide weatherproof while in use, GFCI, receptacles; quantity as required such that a receptacle is within 25 feet of front and rear sides of all equipment, without having to route and extension cord over equipment. Do not place receptacles on the switch or transformer enclosures.
- Communications – All Switch controls, settings, meters, and other devices shall communicate via ModBus, DNP3, or other open protocol, secure, communication language.

Provide lightning protection system certified with a UL Lightning Protection Inspection Certificate to UL 96A and IAW NFPA 780 and IEEE C2 for the WTBn Switchyard.

See drawings in Part 6 for additional information.

G401001 SF₆ SWITCHES

Available switch manufacturers include, but are not limited to:

- S & C Vista
- G&W TNI Switch with Type 3 EZ Set
- ABB Reliapad
- Or Proven Equivalent

Provide SF₆ switch, auxiliary contacts, motor operator, and cable entrance terminations contained in a sealed, dielectric-filled stainless steel tank. A gas-fill valve shall be provided. A temperature-compensated pressure gauge shall be provided that is color coded to show the operating range. The gauge shall be mounted inside the gas-tight tank (visible through a large viewing window) to provide consistent pressure readings regardless of the temperature or altitude at the installation site. The tank shall be submersible and able to withstand up to 10 feet of water over the base. The tank shall be of welded construction and shall be made of Type 304L stainless steel,

The switches shall conform to or exceed the applicable requirements of the following standards and codes:

- The applicable portions of ANSI C57.12.28, covering enclosure integrity for pad-mounted equipment.
- The applicable portions of ANSI C37.71, ANSI C37.72, ANSI C37.73, IEC 56, and IEC 265-1 (Class A), which specify test procedures and sequences for the load-interrupter switches, fault interrupters, and the complete switchgear assembly.
- The applicable portions of IEC 298, Appendix AA covering arc resistance, through 25 kA for 15 cycles.
- The SF₆ gas shall conform to ASTM D2472.

Switchgear shall be shipped factory filled with appropriate levels of SF₆ gas. The gas-tight tank shall be evacuated prior to filling with SF₆ gas to minimize moisture in the tank.

Configure SF₆ switches with load interrupting and fault interrupting switched ways as indicated herein and on the drawings in Part 6. Provide switches with accessible terminations suitable for cables entering from below with manual operating capable of hot-stick operation per IEEE C37.74 and a motor operator for remote operation. Switch contact positions for switched ways shall be visible through viewing windows in the switch compartment located adjacent to the manual operating provisions. All ways shall have a grounding switch. Provide each switched way with three position switch; Open, Closed, Ground. Switch compartments shall be mounted atop a fiberglass stand for ease of maintenance.

Motor Operators and Controls: Motor operators shall be furnished for the load-interrupter switches indicated. All switch-ways without motors shall still include the actuator arm within the tank with all provisions for future installation of a motor operator. Each motor operator shall have its own control board, located within the low-voltage compartment/enclosure. The control board shall have push buttons for locally operating the switches between the closed, open, and grounded positions. Each control board shall have position indicating lamps to show the closed, open, and grounded state of the motor operator. Each motor operator control board shall have a non-resettable, 4-digit-minimum operation counter, which will only increment on a closed-to-open transition. Each motor operator control board shall have an adapter for a portable remote control device, which will allow the user to activate the motor operator at a maximum distance of 50 feet from the gear. No decoupling or any adjustments shall be required to manually operate a motor operator. Removing the motor operator for decoupling shall be a simple, quick process requiring only standard tools. The motor operator shall be water-tight. It shall not be possible for the motor operator to be changed from the closed position directly to the grounded position using local push buttons or remote SCADA control. The grounded position shall be directly accessible only from the open position. When the motor operator is decoupled from the switch, it shall be mechanically interlocked to prevent its being placed back on to the switch in the incorrect position. An integral means for testing the position indicating lamps on the motor controls shall be provided. Controls shall be easy to operate with or without high-voltage rubber gloves and protectors.

A microprocessor-based overcurrent control shall be provided to initiate fault interruption. The control shall be removable in the field without taking the gear out of service. Control settings shall be field-programmable using a personal computer connected via a data port to the control. The data port shall be accessible from the exterior of the enclosure. Neither external power nor energization of the gear shall be required to set or alter control settings. Power and sensing for the control shall be supplied by integral transformers. The minimum total clearing time (from initiation of the fault to total clearing) for fault interruption shall be 40 milliseconds (2.4 cycles) at 60 hertz. Control shall include time-current characteristic (TCC) curves including standard E speed, K-speed, coordinating-speed tap,

coordinating-speed main, and relay curves per IEEE C37.112. Coordinating-speed tap curves shall optimize coordination with load-side weak-link/backup current-limiting fuse combinations, and coordinating-speed main curves shall optimize coordination with tap-interrupter curves and upstream feeder breakers and utility protection relays.

The standard E-speed curve shall have phase-overcurrent settings ranging from 25E through 400E. The standard K-speed curve shall have phase-overcurrent settings ranging from 25K through 200K. The coordinating-speed tap curve shall have phase-overcurrent and independent ground-overcurrent settings ranging from 50 amperes through 400 amperes. The coordinating-speed main curve shall have phase-overcurrent settings ranging from 100 amperes through 800 amperes and independent ground-overcurrent settings ranging from 100 amperes through 400 amperes. Time-current characteristic curves shall conform to the following: IEEE C37.112-1996 IEEE Standard Inverse-Time Characteristic Equations for Overcurrent Relays: U.S. Moderately Inverse Curve U1, U.S. Inverse Curve U2, U.S. Very Inverse Curve U3, U.S. Extremely Inverse Curve U4, U.S. Short-Time Inverse Curve U5, I.E.C. Class A Curve (Standard Inverse) C1, I.E.C. Class B Curve (Very Inverse) C2, I.E.C. Class C Curve (Extremely Inverse) C3, I.E.C. Long-Time Inverse Curve C4, and I.E.C. Short-Time Inverse Curve C5.

The control shall have field-adjustable instantaneous-trip settings (0.2 kA through 6 kA) and definite-time delay settings (32 ms through 96 ms for coordinating-speed tap and 64 ms through 128 ms for coordinating-speed main), to allow tailoring of the coordinating-speed tap and coordinating-speed main curves to the application. Event records shall be easily extractable from the control using a personal computer connected to the data port.

Provide 120-volt transformers within each switch to power the controls and motors.

All primary switches (ways) shall be rated 35 kV, 600 amps, 12.5 kAIC symmetrical and shall be provided with heavy-duty MOV distribution class surge arrestors on each switch way.

- 35kV / 12.5kA rating
- 600 Ampere
- SF₆ interrupter
- (2) auxiliary switches for remote indication
- Fault Indicators on each connection
- Potential Indication with Test Feature
- Two-Hole Ground Pads
- Pad-Mounted Style, 304 Stainless Steel Tank, Mild Steel Enclosure, Fiberglass base
- Remote Low-Pressure Alarm
- All ways shall have a grounding switch.
- Remote Indication
- Test Panel
- Supervisory Control
- Communications Card
- Overcurrent Lockout
- Motor operators
- Heavy duty MOV distribution class surge arrestors on each switch way

All secondary switches (ways) shall be rated 15 kV, 600 amps, 12.5 kAIC symmetrical and have the following features:

- 600 Ampere
- SF₆ interrupter
- (2) auxiliary switches for remote indication
- Fault Indicators on each connection

- Potential Indication with Test Feature
- Two-Hole Ground Pads
- Pad-Mounted Style, 304 Stainless Steel Tank, Mild Steel Enclosure, Fiberglass base
- Remote Low-Pressure Alarm
- All ways shall have a grounding switch.
- Remote Indication
- Test Panel
- Supervisory Control
- Communications Card
- Overcurrent Lockout
- Motor operators
- Heavy duty MOV distribution class surge arrestors on each switch way

Provide SCADA control cabinet in separate enclosure at the end of each switch line-up:

- SCADA Controller –
 - Provide real time automation controller which shall seamlessly integrate and communicate with the SCADA control at the NOC substation via SM FO OSP
 - SCADA controller shall include an integrated IEC 61131-3 programming environment with the ability to monitor and control every protective relay and Ethernet distributed I/O module in the substation continuously.
 - Provide three Form C binary output contacts. Each output contact shall be programmable so that user applications can activate the output contacts
 - Controller shall have a light sensor and accelerometer that can be programmed to detect intrusion and unauthorized tampering.
 - Controller shall be capable of receiving synchronized phasor measurement data via the IEEE C37.118 protocol on all serial and Ethernet ports to as fast as 60 messages per second.
 - SCADA shall provide metering and monitoring for the following measurements:
 - AC current (amperes) in A, B and C phase, 3-phase average, Neutral (N) and Ground (G). A total of five (5) current inputs shall be provided. Accuracy of all current inputs shall be 0.05% reading, +/- 0.01% of full scale.
 - AC voltage (volts) for A-B, B-C and C-A, phase average, A-N, B-N and C-N, average phase to N, and N to G. Accuracy of all voltage inputs shall be +/- 0.1% reading, +/- 0.05% maximum of full scale
 - Auxiliary AC voltage (volts) for A2-B2, B2-C2, and C2-A2, phase average. Accuracy of all voltage inputs shall be +/- 0.1% reading, +/-0.05% maximum of full scale. Capable of metering up to 600 volt without external Potential Transformers (PTs) and up to 500 kV with appropriate PTs.
 - Real Power (Watts), Reactive Power (vars), Apparent Power (VA), for each phase and system. Accuracy +/- 0.10% reading and +/- 0.0025% full scale. Forward/Reverse indication shall be provided.
 - Frequency (Hz) Accuracy +/- 0.01 hertz.
 - Demand values including present, running average, last complete interval and peak for System Current (Amperes). Demand values including present, running average, last complete interval, peak and coincident with peak kVA and kW demand for System Real Power (Watts), System Reactive Power (vars), and System Apparent Power (VA).
 - Power Factor for both Displacement only 60-cycle fundamental Watts to VA and Apparent total Watts to total vars including harmonics for A, B and C phase and 3-phase average. Accuracy +/- 0.10% at unity PF and +/-0.30% at 0.5 PF.
- 2GB local non-volatile memory storage

- Ports: 1 USB, 2 Ethernet, 1 fiber optic, 4 Serial
- Operating Temp: -40° to +85° C
- Conformal Coated Circuit Boards
- Connect and monitor or control all switch controls, meters, and protective device settings and alarms, and communicate alarms and trouble events
- Controller shall include a ten-year, no-questions-asked warranty for all material and workmanship defects.
- The controller shall provide the following protocols: Server: SES-92, IEC 61850 MMS, IEC 870-5-101/104, Client: CP2179, SEL ASCII and Binary, Client/Server: DNP3 serial, DNP3 LAN/WAN, Modbus® RTU, Modbus TCP, LG8979, IEEE C37.118, Peer-to-Peer: IEC 61850 GOOSE transmit and receive messages
- 120vac control power
- Cabinet heater and humidistat

Source-Transfer Control Operating Description: The source transfer function shall be initiated manually. Provide motor operators and open/close/ground pilot devices at each switch-way. Provide kirk key interlock to ensure sources cannot be inadvertently closed at the same time.

Provide interlock that will open the 34.5kV source switch if the transformer secondary switch is opened.

G401002 TRANSFORMERS

Provide substation transformer at the WTBn Switchyard as indicated above in G4010.

For the MSAU HQ-BEQ and MCESG Annex: Provide a 3-phase 13.2kV-480Y/277v pad mounted transformer to feed each building.

Provide a pad mounted transformer at the WTBn Switchyard to provide power for lighting, receptacles, and other incidental loads.

Transformers shall include the following features:

- Biodegradable less-flammable FR3 type liquid-insulated.
- 95kV BIL
- Three surge arresters for radial feed circuits.
- Dead-Front Design with ANSI specific front plate spacing
- Bushings shall be 15kV 200A bushing wells with bushing well inserts installed. The bushings shall be externally removable
- Radial feed switch
 - 15kVswitch
 - Externally removable Bay-O-Net expulsion type current limiting fuses.
 - Load break current: 200A minimum
- Transformers shall be provided with Nexus 1272 AMI meter and communication seamlessly compatible with the Quantico base metering standards.
- Fault indicators on each connection
- Two – 2 ½% taps above and below rated voltage
- Pressure-relief valve
- 55 deg C
- Sudden Pressure relief relay activation indicator with remote monitoring capable/digital output
- Top oil temperature indicator with remote monitoring capable/digital output
- Winding temperature indicator with remote monitoring capable/digital output

- Low Liquid level indicator with remote monitoring capable/digital output
- Nexus 1272 AMI meter (connect to existing AMI network)

G401004 OVERHEAD ELECTRIC CONDUCTORS

Provide poles, risers, and loadbreak fused cutouts IAW UFC 3-550-01 *Exterior Electrical Power Distribution with Change 1* when connecting to the existing overhead services.

All new exterior electrical work shall be underground.

G401005 TOWERS, POLES, CROSSARMS AND INSULATORS

Poles for overhead power distribution shall be wood.

Provide loadbreak fused cutouts on all new poles.

Provide new or replace existing loadbreak fused cutouts when connecting at an existing pole. Provide 35kV, 200A, 10kAIC rated loadbreak fused cutouts and 15kV, 300A, 10kAIC loadbreak fused cutouts.

G401006 UNDERGROUND ELECTRIC CONDUCTORS

For 600V or lower circuits provide XHHW-2 insulated copper conductors underground in conduit.

Provide a medium voltage and 600 volt secondary underground electrical power distribution systems to meet the connection requirements as indicated in paragraph G4010 "Electrical Distribution" and IAW the latest edition of UFC 3-550-01 *Exterior Electrical Power Distribution*.

Provide fused cut-outs on connections to overhead distribution systems. Splicing of medium voltage cables underground is not acceptable; provide deadbreak connectors in pad mounted sectionalizing cabinets. Medium voltage cables shall be as indicated in paragraph G4010 and in UFC 3-530-01. Provide a new 34.5kV pole and riser adjacent to the NOC Substation. Coordinate connection to overhead 34.5kV with Quantico PWD engineer.

Provide a system of 4-way, 6-inch, concrete encased 38kV class primary ductbank and pad mounted sectionalizing cabinets from the WTBn Switchyard to a new pole location adjacent to the existing NOC Substation. All medium voltage ductbank shall be buried a minimum of 36 inches to the top of concrete. Splices shall be not permitted except within a pad mounted sectionalizing cabinet.

Pad Mounted Sectionalizing Cabinets:

Comply with IEEE Std C57.12.28-2014 - IEEE Standard for Pad-Mounted Equipment – Enclosure, IEEE Std C57.12.38-2014 - IEEE Standard for Pad-Mounted-Type, Self-Cooled, Single-Phase Distribution, and IEEE Std 386 - IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V. The sectionalizing enclosure shall be continuous seam-welded and manufactured of minimum 12-gauge steel. All hardware shall be stainless steel. Enclosure shall include a top hinged removable cover and allow one person operation. Cover must also include a wind stop to prevent accidental closing and include a deep angled recessed door with low sill for easy accessibility. Enclosure shall include universal mounting plates for cable terminations and must accept 600 A, 35 kV, three-position deadbreak junctions. Enclosure shall include parking stand design providing multiple options for parking of accessories and providing rigidity to the back of the enclosure to prevent oil-canning during operation. Enclosure shall be lockable for security.

G401007 DUCTBANKS, MANHOLES, HANDHOLES AND RACEWAYS

Provide a system of concrete encased ductbanks, handholes, manholes, and pad mounted sectionalizing cabinets for all underground power distribution system as indicated in UFC 3-550-01. All new electrical site distribution shall be underground.

Provide a manhole near the WTBn Switchyard distribution switchgear to lineup for routing of new feeders. The manhole shall be provided in a suitable location to enable the future feeders to be routed to the distribution switchgear.

Provide pad mounted sectionalizing cabinets and route 35kV conductors through cabinets. Provide pad mounted sectionalizing cabinets wherever splices are required, where duct lines change direction, and within 100 feet of every riser pole, pad mounted transformer, or unit substation. Cabinet separation through bends or curved runs shall not exceed 400 feet. In straight runs where greater separation is desired pulling plans and pulling tension calculations shall be provided to prove the greater separation does not result in excessive pulling tension.

G401008 GROUNDING SYSTEMS

Provide a complete grounding system for the electrical power distribution system and fences. Grounding System at each building shall not exceed 5 ohms.

Provide a counterpoise with at least four (4) ground rods around each building transformer pad.

WTBn Switchyard Grounding: Provide a complete substation multi-point grounding system for the WTBn Switchyard in accordance with UFC 3-550-01, IEEE Std 80, and IEEE C2. Resistance to ground of the completed system shall not exceed 5 ohms; if any special equipment installed requires a lower ground system resistance, then that equipment manufacturer's maximum ground resistance shall apply. Provide an equipotential grounding mesh grid (EPG) underground within the fenced perimeter of the switchyard. Provide an underground counterpoise with at least eight (8) ground rods surrounding the equipment pad. Provide an underground counterpoise with ground rods spaced in accordance with IEEE C2 along the complete fence line, bonded to the fence in accordance with UFC 3-550-01 and IEEE C2. Bond all portions of the grounding system using exothermic welds.

G401009 METERING

Provide a separate Meter for each Pad Mounted Transformer compatible with the existing base AMI metering system. Meters may be transformer mounted or mounted in the main switchboard. Provide communication to the AMI system. Electrical meters shall be Nexus model 1272.

Contractor shall provide and install AMI capable meters for all utilities utilized during facilities construction and utilized for the completed facilities. Additionally, until contractor provided facility meter is integrated into existing AMI system, the contractor shall take monthly readings on all utilities on or about the 15th of every month. Utility meter readings taken monthly shall be provided to MCB Quantico Energy Management team for analysis and energy reporting purposes. All new metering shall seamlessly integrate into the existing primary MCB Quantico AMI application database utilizing existing communication infrastructure, network protocols, and data storage. If existing communication infrastructure is not available then contractor shall provide. New metering shall integrate seamlessly into the existing MCB Quantico AMI Cybersecurity Authority to Operate (ATO). Existing cybersecurity package for AMI shall simply require an update for all new AMI to be added to existing AMI system. Contractor shall provide update and all support needed to achieve approval for updated cybersecurity ATO for existing AMI system.

G401011 EQUIPMENT REQUIREMENTS FOR COASTAL AND HIGH HUMIDITY AREAS

Not Used

G4020 SITE LIGHTING

Provide site lighting for exterior including underground distribution, handholes, grounding, poles, fixtures and controls as required for a complete and usable system. All exterior lighting shall comply with UFC 3-530-01 *Interior and Exterior Lighting Systems and Controls*.

Maximum correlated color temperature (CCT) for exterior lighting shall be 4000 Kelvin and shall match the CCT of the existing LED luminaires recently installed on adjacent sites, for an consistent appearance across the campus. Coordinate the CCT of all pole mounted, bollard, and building mounted exterior fixtures such that the color temperature does not deviate more than 10% of the average CCT across the Embassy Security Group campus.

All exterior lighting shall be LED with a maximum drive current of 550mA. Maximum CCT shall be 4000 for exterior luminaires; exterior color rendering index shall be 70 or higher. All LED lighting fixtures, poles and appurtenances shall include a minimum 5-year warranty.

Poles and Luminaires shall comply with the Base Appearance Plan and shall match existing site lighting pole and luminaires on the Embassy Security Group Site.

Provide site lighting with an average illumination level of 5fc for the training field adjacent to the MSAU HQ-BEQ. Provide power and control from within the building. Provide switch and photoelectric sensor.

G402001 EXTERIOR LIGHTING FIXTURES AND CONTROLS

Provide LED type lighting fixtures, complete with field serviceable LED components.

Provide Area and Parking Lighting for parking lots, walkways, driveways and pedestrian areas. Provide lighting for the sign and at the exterior training areas.

Provide flagpole lighting consisting of at least three (3) ground-mounted, aimable, LED narrow beam flood lights. Install setback from the pole at a distance of 1/3 the pole height, and 120 degree separation between fixtures.

Provide an automatic lighting control system for exterior lighting fixtures utilizing photocell switches backed up with time based controls such that lighting will automatically turn "ON" at dusk and turn "OFF" at user-programmable time or dawn, whichever comes first.

WTBn Switchyard Lighting: Provide LED area and flood lighting within the WTBn Switchyard mounted on wooden poles. Consider the switches, transformer, and the area within 10' of equipment and between equipment enclosures to be critical and illuminate to 30fc average horizontal and 40fc vertical on all accessible equipment facades, with a 5:1 maximum avg:min ratio. Illuminate the remainder of the switchyard to 20fc average, 10:1 ratio maximum. Each pole may include one LED area luminaire mounted at a maximum of 30 feet and two (2) LED floodlights mounted below the area light. Floodlights shall be mounted on arms so as not to block the area light distribution and shall be amiable. Provide a local switchyard pad mounted transformer to provide power for lighting and receptacles. Light control shall be by manual switches only. Provide separate switches for area luminaires and flood lighting, located adjacent to entry gate.

G402003 OTHER AREA LIGHTING

Provide area lighting for equipment wash down and drying areas, physical training areas, and recreational areas in accordance with UFC 3-530-01 *Interior and Exterior Lighting Systems and Controls*.

Provide sign lighting at 5fc vertical, 3:1 max:min ratio.

G402004 LIGHTING POLES

Provide steel poles complete with foundations for site lighting. Provide hinged CCTV pole to lower CCTV cameras down to ground level for safe maintenance and repair. The pole shall be capable to accommodate multiple fixed and PTZ cameras. The pole and arms shall have an internal wireway to conceal all cables. It shall provide top reflection (operational wind speed) of less than one (1) degree. Poles shall match existing on Embassy Security Group Site. Provide matching appurtenances for mounting of security cameras or other poles mounted devices. Provide handhole in each pole.

Provide barcode identification for each light pole; coordinate with Quantico PWD regarding barcode format. Provide Quantico with complete list of all barcodes and pole locations in a format appropriate for Maximo input.

G402005 UNDERGROUND ELECTRIC CONDUCTORS

Provide a complete underground distribution system for all site lighting systems.

G402006 DUCTBANKS, MANHOLES AND HANDHOLES

Provide a direct buried underground system including conduits and handholes to meet the connection requirements indicated in paragraph G4020 "Site Lighting".

G402007 GROUNDING SYSTEMS

Provide a ground rod for each light pole and bond pole to ground rod with minimum 6AWG copper conductor.

G4030 SITE COMMUNICATION AND SECURITY

Provide a complete operational turnkey Outside Plant (OSP) systems including, but not limited to ductbanks, copper and fiber distribution, entrance protectors, patch panels, connectors, all raceway, cable trays, cabling, terminations, jacks, faceplates, patch cords poles and structures, and grounding systems as required for a complete and usable system.

G403001 TELECOMMUNICATIONS SYSTEMS

The location of available telecommunication points of connection and the proposed P-707 facilities are indicated on the Civil Utilities Plan. From the existing manhole, centrally located between the proposed MSAU HQ-BEQ and MCESG Annex buildings, southwest of proposed MSAU HQ-BEQ (Refer to Civil Utility Plan). Install two (2) new 2-way 4-inch underground conduits to MSAU HQ-BEQ Telecom Entrance Facility (TEF) and two (2) new 2-way 4-inch underground conduits to MCESG Annex telecom room. Provide nylon pull strings and one (1) 3-inch 3-cell innerduct in each conduit. These conduits shall be encased in concrete where crossing roads, parking areas and other similar locations. Provide any additional Hand Hole/Manhole as required by ANSI/TIA/EIA-758.

The existing manhole located, southeast of the proposed P-707 (Refer to Civil Utility Plan - Point "A"), is the new Point of Connection (POC) to the proposed MSAU HQ-BEQ and MCESG Annex. Furnish and install 12-strand, single mode fiber and 25 pair of copper from the POC to the MSAU HQ-BEQ TEF. Splice new fiber and copper to the existing fiber and copper in the POC's manhole. Terminate OSP fiber and copper in the MSAU HQ-BEQ TEF. The OSP copper cables shall be terminated on primary protector blocks with solid state modules. Furnish and install 12-strand, single mode fiber and 25 pair of copper from the POC to the MCESG Annex telecom room. Splice new fiber and copper to the existing fiber and copper in the POC's manhole. Terminate OSP fiber and copper in the MCESG Annex's telecom room. The OSP copper cables shall be terminated on primary protector blocks with solid state modules. Minimize splicing to the greatest extent possible; all splices shall occur in manholes.

Furnish and install 25 pair of copper and 12-strand, single mode fiber optic cables from the MSAU HQ-BEQ TEF to the MCESG Annex telecom room and terminate at both ends. Furnish and install 25 pair of copper and 12-strand, single mode fiber optic cables from MSAU HQ-BEQ TEF to the Primary CAC of existing P-621 and 25 pair of copper and 12-strand, single mode fiber optic cable from MCESG Annex telecom room to P620.

All empty conduits and ducts shall be sealed, capped, tagged and marked at each end. Outside Plant Communications design shall be coordinated with G6 and in accordance with Unified Facilities Criteria, ANSI/TIA/EIA-758 and NMCI requirements, and shall be stamped by Outside Plant Registered Communication Distribution Designer (RCDD-OSP).

Install 12-strand SM FO OSP for medium voltage SCADA connectivity from the new WTBn switchyard to the existing SCADA controller in the NOC substation. Provide a system of 2-way, 4-inch underground ductbank with fabric mesh innerducts parallel to the MV ductbank. Provide a handhole adjacent to each MV cabinet and manhole. Locate and connect at the NOC substation as directed by the government.

G403002 CABLE TV SYSTEMS (CATV)

One (1) 2-inch underground conduit shall be provided from the MSAU HQ-BEQ and MCESG Annex TEF to five (5) feet outside the building for CATV cable. Commercial television provider will provide service cable into the building entrance facilities.

G403003 CABLES AND WIRING

Cables and wiring for site telecommunications systems shall be as indicated in their respective categories.

G403004 DUCTBANKS, MANHOLES AND HANDHOLES

Provide a system of ductbanks, manholes, and handholes for site telecommunications.

G403009 GROUNDING SYSTEMS

Provide a complete grounding system for all site communications and security systems.

-- End of Section --